NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND

(No.)
CODE 378

DEFINITION

A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is 3 ft or more.

PURPOSE

To provide water for livestock, fish and wildlife, recreation, fire control, irrigation, and other related uses to reduce downstream flooding and to maintain or improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

Hazard and Size. This standard establishes the minimum acceptable quality for the design and construction of low hazard ponds where:

1. Failure of the dam will not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, or railroads; or in interruption of the use or service of public utilities.

2. The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway. The effective height of the dam is the difference in elevation, in feet, between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam. If there is no auxiliary spillway, the top of the dam is the upper limit.

3. The effective height of the dam is 35 ft or less, **and** the dam is a low hazard potential (formerly NRCS class “a”).

4. The dam does not exceed limits for class III, small or intermediate, as defined by Illinois Department of Natural Resources, Office of Water Resources. (ref. IDNR Rules & Regulations for construction and maintenance of dams.)

5. Landowner, or other responsible party, has secured necessary permits, if required, for design and construction from IDNR, OWR. Table 1 lists class III dams by dam height and storage and whether or not a permit is required.* Dam height is the difference, in feet, measured from the natural bed of the stream or watercourse at the downstream dam slope or toe of the barrier to the top of the embankment or barrier.

TABLE 1 - REQUIREMENT FOR IDNR PERMIT CLASS III DAMS.

Dam Ht* (ft)	Storage to top of Dam (ac-ft)	Permit Required
0 - 6	All	No
6 - 25	< 50	No
6 - 25	> 50	Yes
> 25	< 15	No
> 25	> 15	Yes

Site conditions. Site conditions shall be such that runoff from the design storm can be safely passed through (1) a natural or constructed auxiliary spillway, (2) a principal spillway, or (3) a combination of a principal spillway and an auxiliary spillway.

Investigations. Sufficient investigations shall be made of the structure site and borrow areas to determine the suitability of site and materials for construction, water holding ability and structure stability.

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and groundwater will provide an adequate supply of water for the intended purpose, unless an alternate source exists to serve this purpose. The quality shall be suitable for the water's intended use.

Reservoir area. The topography and geology of the site shall permit storage of water at a depth and volume that ensure a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. If surface runoff is the primary source of water for a pond, the soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable.

Ponds for fish production. The minimum surface area shall be 0.5 acre. Ponds shall be at least 9' deep over an area of 1000 sq. ft. in Henderson, Iroquois, Knox, Livingston, Peoria, Warren and Woodford and all counties north thereof. The shoreline, excluding the embankment and waterway outlets into the pond, shall be steepened to a slope of 2:1 from the normal water surface to a depth of 3 ft; on ponds with a surface area of 6 acres or greater this requirement may be reduced to 75% of the shoreline. For ponds larger than 3 acres, provisions shall be made to drain the pond in a 14-day period. An available pumping system of adequate size will meet the drawdown requirement.

DESIGN CRITERIA FOR EMBANKMENT PONDS

Geological Investigations. Pits, borings, review of existing data or other suitable means of investigation shall be conducted to characterize materials within the embankment foundations, auxiliary spillway and borrow areas. Soil materials shall be classified using the Unified soil classification System. A complete analysis of foundation and earth fill materials shall be made when, in the opinion of the engineer, such analysis is needed.

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam if necessary to reduce seepage through the foundation. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough to extend into a relatively impervious layer or provide for a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall not be steeper than one horizontal to one vertical.

Seepage control. Seepage control shall be provided in all embankments over 25 feet high. For embankments less than 25 feet high, seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage could create swamping downstream, (3) such control is needed to insure a stable embankment, or (4) special problems require drainage for a stable dam. Seepage may be controlled by (1) foundation, abutment, or embankment drains; (2) reservoir blanketing; or (3) a combination of these measures.

Earth embankment. The minimum top width for a dam is shown in table 2. If the embankment top is to be used as a public road, the minimum width shall be 16 ft for one-way traffic and 26 ft for two-way traffic. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority.

Table 2.- Minimum top width for dams

Total height of embankment	Top width
ft	*Ft*
10 or less	6
10 - 15	8
15 - 20	10
20 - 25	12
25 - 35	14
35 or more	15

* Total height of embankment is the difference in feet from the low point along the centerline of dam to the constructed top of dam.

Side Slopes. The combined upstream and downstream side slopes of the settled embankments shall not be less than five horizontal to one vertical, and neither slope shall be steeper than two horizontal to one vertical. All slopes must be designed to be stable, even if flatter side slopes are required.

Slope Protection. If needed to protect the slopes of the dam from erosion, special measures, such as berms, rock riprap, sand-gravel, soil cement, or special vegetation, shall be provided (Technical Releases 56 and 69 contain design guidance).

Freeboard. The minimum elevation of the top of the settled embankment shall be 1 ft above the water surface in the reservoir with the auxiliary spillway flowing at design depth. The minimum difference in elevation between the crest of the auxiliary spillway and the settled top of the dam shall be 2 ft for all dams having more than a 20-acre drainage area or more than 20 ft in effective height.

Settlement. The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. This increase shall not be less than 5 percent of the height of the embankment, except where detailed soil testing and laboratory analyses show that a lesser amount is adequate. The height shall be increased by 10% when fill material is pushed up and compacted by a bulldozer.

Principal spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam, except where rock, concrete, or other types of lined spillways are used, or where a vegetated or earth spillway can safely handle the rate and duration of flow.

For dams having a drainage area of 20 acres or less, the principal spillway crest elevation shall not be less than 0.5 ft below the auxiliary spillway crest elevation. For dams with a drainage area over 20 acres, this difference shall not be less than 1.0 feet.

When design discharge of the principal spillway is considered in calculating peak outflow through the auxiliary spillway, the crest elevation of the inlet shall be such that full flow will be generated in the conduit before there is discharge through the auxiliary spillway.

Pipe conduits designed for pressure flow must have adequate anti-vortex devices. The inlets and outlets shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

The capacity of the pipe conduit shall be adequate to discharge long-duration, continuous, or frequent flows without flow through the auxiliary spillways. The diameter of the pipe shall not be less than 4 in. If the pipe conduit diameter is 10 in or greater, its design discharge may be considered when calculating the peak outflow rate through the emergency spillway.

The minimum capacity for pipe conduits shall be adequate to discharge the runoff from the frequency storm in Table 3 for non-permit dams, or Table 4 for permit dams without auxiliary spillway flows.

Table 3. Spillway Capacity Requirements – Non Permit Dams – Storage < 50 Ac. Ft.

Drainage Area	Effective Fill Ht.	Minimum Design Freq. (24 Hour Storm)	
		Principal Spillway	Emergency Spillway
Acres	Feet	Years	Years
0 – 20	0 – 20	5	25
0 – 20	21 – 35	10	25
> 20	0 – 20	10	25
> 20	21 - 35	10	50

For drainage areas of 250 acres or less, routings may be made using approximate reservoir routing methods found in Chapter 11 of the Engineering Field Handbook. For drainage area larger than 250 acres, use routing methods presented in NEH–4, TR–33, Dams 2 or other Accepted methods.

Table 4. Spillway Capacity Requirements – Class III Permit Dams

Drainage Area	Effective Fill Ht.	Minimum Design Freq. (24 Hour Storm)	
		Principal Spillway	Emergency Spillway
Acres	Feet	Years	Years
All	All	25	100

Materials. Pipe conduits shall be ductile iron, welded steel, corrugated steel, corrugated aluminum, reinforced concrete (precast or sitecast), or plastic. Pipe conduits through dams of less than 20 feet total height may also be cast iron or un-reinforced concrete.

Pipe conduits shall be designed and installed to withstand all anticipated external and internal loads without yielding, buckling, or cracking. Flexible pipe shall be designed for a maximum deflection of 5 percent. The modulus of elasticity for plastic pipe shall be assumed as one-third of the amount designated by the compound cell classification to account for long term reduction in modulus of elasticity values for the pipe. The minimum thickness of flexible pipe shall be SDR 26, Schedule 40, Class 100, or 16 gage as appropriate for the particular pipe material. Rigid pipe shall be designed for positive projecting conditions. Connections of flexible pipe to rigid pipe or other structures shall be designed to accommodate differential movements and stress concentrations.

All pipe conduits shall be designed and installed to be water tight by means of couplings, gaskets, caulking, waterstops, or welding. Joints shall be designed to remain watertight under all internal and external loading including pipe elongation due to foundation settlement.

All steel pipe and couplings shall have protective coatings in areas that have traditionally experienced pipe corrosion, or in embankments with saturated soil resistivity less than 4000 ohms-cm or soil pH less than 5. Protective coatings shall be asphalt, polymer over galvanizing, or coal tar enamel as appropriate for the pipe type. Plastic pipe that will be exposed to direct sunlight shall be ultraviolet-resistant and protected with a coating or shielding, or provisions provided for replacement as necessary.

Pipe conduits shall have a concrete cradle or bedding if needed to provide improved support for the pipe to reduce or limit structural loading on pipe to allowable levels.

Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed. Other suitable devices such as a Saint Anthony Falls stilling basin or an impact basin may be used to provide a safe outlet.

The requirements listed in tables 5, 6, 6A, and 7 are to be followed for polyvinyl chloride (PVC), steel, and aluminum pipe.

Table 5.- Acceptable PVC pipe for use in earth dams[1]

Nominal pipe size	Schedule for standard dimension ratio (SDR)	Maximum depth of fill over pipe
in		*ft*
4 or less	Schedule 40	15
	Schedule 80	20
	SDR 26	10
6,8,10,12	Schedule 40	10
	Schedule 80	15
	SDR 26	10

[1]Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ATSM-D-1785 or ATSM-D-2241.

Table 6.- Minimum gage for corrugated metal pipe [2-2/3-in x ½-in corrugations][1]

Fill Height (ft)	Minimum gauge for steel pipe with diameter (in) of —— 21 and less	24	30	36	42	48
1 - 15	16	16	16	14	12	10
15 - 20	16	16	16	14	12	10
20 - 25	16	16	14	12	10	10

Fill Height (ft)	Minimum thickness (in) of aluminum pipe[2] with diameter (in) of —— 21 and less	24	30	36
1 - 15	0.06	0.06	0.075	0.075
15 - 20	0.06	0.075	0.105	0.105
20 - 25	0.06	0.105	0.105	----[3]

[1] Pipe with 6-, 8-, and 10-in diameters has 1-1/2 in x ¼-in corrugations.

[2] Riveted or helical fabrication.

[3] Not permitted.

Table 6A. Minimum Gauges – Corrugated Steel Pipe – 3” by 1” Corrugations

Pipe Diameter	Fill Height Above Pipe (Feet)		
(Inches)	1 – 15	15 – 20	20 – 25
36 – 42	16	16	16
48	16	16	14
54	16	16	12
60	16	14	10
66	16	14	8
72	16	14	8
78	14	12	8
84	12	10	*
90	12	8	*
96	10	*	*

* Not Permitted

Table 7. Welded Steel Pipe - Maximum Allowable Fill Over Pipe (Feet)

Pipe Wall	*Pipe Diameter (Inches)*									
Thickness (Inches)	*12*	*14*	*16*	*18*	*20*	*22*	*24*	*30*	*36*	*42*
.141	*8*	*5*	*3*	*3*						
.172	*14*	*9*	*6*	*5*	*3*	*3*				
.188	*18*	*12*	*8*	*6*	*4*	*3*	*3*			
.219	*27*	*18*	*12*	*9*	*6*	*5*	*4*			
.250	*42*	*26*	*18*	*13*	*9*	*7*	*6*	*3*		
.312			*36*	*26*	*19*	*15*	*12*	*6*	*3*	*3*
.375				*44*	*32*	*25*	*20*	*9*	*6*	*4*
.438						*40*	*33*	*15*	*9*	*6*
.500							*46*	*24*	*14*	*9*

New reject or high quality used steel pipe may be used for principal spillway conduits under the following conditions:

(1) Structure is Job Class III or less.

(2) Pipe is of high quality and free of excessive rust and pitting.

(3) Pipe wall thickness is .312 inch, or greater.

Corrugated plastic tubing/pipe with smooth interior may be used. The procedure for qualifying corrugated plastic pipe with smooth interior for installation in fills is set forth in Illinois Bulletin 210-2-7, April 1992.

Cathodic Protection. Cathodic protection is to be provided for coated welded steel and galvanized corrugated metal pipe where soil and resistivity studies indicate that the pipe needs a protective coating, and where the need and importance of the structure warrant additional protection and longevity. If cathodic protection is not provided for in the original design and installation, electrical continuity in the form of joint-bridging straps should be considered on pipes that have protective coatings. Cathodic protection should be added later if monitoring indicates the need.

Practice standard 430-FF provides criteria for cathodic protection of welded steel pipe.

Seepage Control. Seepage control along a pipe conduit spillway shall be provided if any of the following conditions exist:

1. The effective height of dam is greater than 15 ft.
2. The conduit is of smooth pipe larger than 8 in. in diameter.
3. The conduit is of corrugated pipe larger than 12 in. in diameter.

Seepage along pipes extending through the embankment shall be controlled by use of a drainage diaphragm, unless it is determined that antiseep collars will adequately serve the purpose.

Antiseep collars will be considered adequate for embankments with a relatively impermeable zone up to permanent pool elevation and for all dry dams.

Drainage Diaphragm. The drainage diaphragm shall function both as a filter to eliminate losses of adjacent base soils and a drain for seepage that it intercepts. The drainage diaphragm shall consist of sand meeting the requirements of ASTM C-33 for fine aggregate. If unusual soil conditions exist such that this material may not meet the required filter or capacity requirements, a special design analysis shall be made.

The drainage diaphragm shall be a minimum of 2 ft thick and extend vertically upward and horizontally at least three times the outside pipe diameter, and vertically downward at least 18 in. beneath the conduit invert. The drainage diaphragm shall be located immediately downstream of the cutoff trench, or downstream of the centerline of the dam if the cutoff trench is upstream of the centerline of the dam.

The drainage diaphragm shall be outletted at the embankment downstream toe, preferably using a drain backfill envelope continuously along the pipe to where it exits the embankment. Protecting drain fill from surface erosion will be necessary.

Antiseep Collars. When antiseep collars are used in lieu of a drainage diaphragm, they shall have a watertight connection to the pipe. Maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe. The minimum spacing shall be 10 feet. Collar material shall be compatible with pipe materials. The antiseep collar(s) shall increase, by at least 15 percent, the seepage path along the pipe.

Trash Guard. To prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser unless the watershed does not contain trash or debris that could clog the conduit.

Other Outlets. A pipe with a suitable valve shall be provided to drain the pool area if needed for proper pond management or if required by State law. The principal spillway conduit may be used as a pond drain if it is located where it can perform this function.

Pipe conduits through the dam used solely as a supply pipe for watering troughs and other appurtenances shall have an inside diameter of not less than 1-1/4 inches.

Auxiliary Spillways. Auxiliary spillways convey large flood flows safely past earth embankments and have historically been referred to as "Emergency Spillways".

An auxiliary spillway must be provided for each dam, unless the principal spillway is large enough to pass the peak discharge from the routed design hydrograph and the trash that comes to it without overtopping the dam. The following are minimum criteria for acceptable use of a closed conduit principal spillway without an auxiliary spillway: a conduit with a cross-sectional area of 3 ft^2 or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash.

The minimum capacity of a natural or constructed auxiliary spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in table 3, less any reduction creditable to conduit discharge and detention storage.

The auxiliary spillway shall safely pass the peak flow, or the storm runoff shall be routed through the reservoir. The routing shall start either with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days' drawdown, of the principal spillway routed storm, whichever is higher. The 10-day drawdown shall be computed from the crest of the auxiliary spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Auxiliary spillways shall provide for passing the design flow at a safe velocity to a point downstream where the dam will not be endangered.

When the principal spillway is a closed conduit with diameter 10" or larger, and drainage area is less than 250 acres, the required capacity of the auxiliary spillway may be computed by subtracting the peak principal spillway design storm flow from the peak auxiliary spillway design storm inflow, in lieu of any routing procedure. The auxiliary spillway will be designed using procedures found in chapter 11 of the engineering field handbook.

Constructed auxiliary spillways are open channels that usually consist of an inlet channel, a control section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or compacted earth or in-situ rock. The side slopes shall be stable for the material in which the spillway is to be constructed. For dams having an effective height exceeding 20 ft, the auxiliary spillway shall have a bottom width of not less than 10 ft.

Upstream from the control section, the inlet channel shall be level for the distance needed to protect and maintain the crest elevation of the spillway. The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed auxiliary spillway shall fall within the range established by discharge requirements and permissible velocities.

Spillway dikes or shaped exit channels shall be used as needed to insure that spillway flows do not damage the earth embankments. The constructed spillway dike shall have a minimum side slope of 2:1, a minimum top width of 4 ft and a minimum height of 2 ft above the outlet channel grade.

Structural auxiliary spillways. If chutes or drops are used for principal spillways or auxiliary spillways, they shall be designed according to the principles set forth in Part 650, Engineering Field Handbook, and the National Engineering Handbook-Section 5, Hydraulics; Section 11, Drop Spillways; and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in table 3, less any reduction creditable to conduit discharge and detention storage.

DESIGN CRITERIA FOR EXCAVATED PONDS

Runoff. Provisions shall be made for a pipe and auxiliary spillway if necessary. (see table 3) Runoff flow patterns shall be considered when locating the pit and placing the spoil.

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than one horizontal to one vertical. If livestock will water directly from the pond, a watering ramp of ample width shall be provided. The ramp shall extend to the anticipated low water elevation at a slope no steeper than three horizontal to one vertical.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

Excavated material. The material excavated from the pond shall be placed so that its weight will not endanger the stability of the pond side slopes and so that it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height that does not exceed 3 ft, with the top graded to a continuous slope away from the pond.
2. Uniformly placed or shaped reasonably well, with side slopes assuming a natural angle of repose. The excavated material will be placed at a distance equal to the depth of the pond but not less than 12 ft from the edge of the pond.
3· Shaped to a designed form that blends visually with the landscape.
4· Used for low embankment and leveling.
5· Hauled away.

CONSIDERATIONS

Visual resource design. The visual design of ponds should be carefully considered in areas of high public visibility and those associated with recreation. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and to attract wildlife.

Cultural Resources. Consider existence of cultural resources in the project area and any project impacts on such resources. Consider conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

Fish and Wildlife.

1. Project location and construction should minimize the impacts to existing fish and wildlife habitat.

2. When feasible, structure should be retained, such as trees in the upper reaches of the pond, stumps in the pool area. Upper reaches of the pond can be shaped to provide shallow areas and wetland habitat.

3. If fish are to be stocked, consider criteria and guidance in Practice Standard 399, Fishpond Management.

Water Quantity

Consider:

1. Effects upon components of the water budget, especially effects on volumes and rates of runoff, infiltration, evaporation, transpiration, deep percolation, and ground water recharge.

2. Variability of effects caused by seasonal or climatic changes.

3. Effects on the downstream flows and impacts to environment such as wetlands, aquifers and social and economic impacts to downstream uses or users.

4. Potential for multiple purposes.

Water Quality

Consider:

1. Effects on erosion and the movement of sediment, pathogens, and soluble and sediment attached substances that are carried by runoff.

2. Effects on the visual quality of onsite and downstream water resources.

3. Short-term and construction-related effects of this practice on the quality of downstream water courses.

4. Effects of water level control on the temperatures of downstream water to prevent undesired effects on aquatic and wildlife communities.

5. Effects on wetlands and water-related wildlife habitats.

6. Effects of water levels on soil nutrient processes such as plant nitrogen use or denitrification.

7. Effects of soil water level control on the salinity of soils, soil water, or downstream water.

8. Potential for earth moving to uncover or redistribute toxic materials such as saline soils.

Fencing. Where an adjacent area is used for grazing or is open to livestock, the pond area, earthfill and vegetative spillway shall be fenced to exclude livestock. Where watering ramps are constructed in an excavated pond, the fence shall permit livestock access to the ramp area only.

Near urban areas, fencing may be necessary to exclude traffic from embankment and spillway vegetation and to prevent the use of facilities for purposes other than intended.

SAFETY. Farm ponds are potential attractive nuisances and safety aspects must be considered in their design and layout. If the area is used or may be used, for recreation, it is recommended that warning signs be erected, that lifesaving equipment be available on site and that emergency instructions be posted in a conspicuous location.

Vegetation. All exposed surfaces of the embankment, earth spillway, borrow areas, and other areas disturbed during construction shall be seeded or sodded.

Seedbed preparation and treatment and the seeding mixtures and methods shall be according to.

PLANS AND SPECIFICATIONS

Plans and specifications for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be developed and reviewed with the landowner or client.